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An Automated System for Determining Applicability of Regulations

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Introduction

Environmental personnel at both federal facilities and in the private sector face the daunting task of tracking regulations at the federal, state, and local levels. Determining which regulations may apply to sources at a facility, whether these sources are in compliance with applicable regulations, and what to do should a source be found to be out of compliance are all time intensive tasks which require a significant level of technical expertise. As part of the development of the Air Compliance Advisor (ACA) software program a regulations data engine was developed using EXL, the special-purpose programming language developed for the ACA. The EXL programming language is well suited to the construction of a means for testing the potential applicability of a set of regulations. This paper provides an overview of the various type of regulations that environmental personnel must consider, the software programs currently available for regulations, and the development of an alternative method for treating regulations.

Overview of Regulations

Environmental regulations exist for a range of levels and in a variety of forms. Each of these regulations must be considered when assessing the compliance status of a source or a facility. Regulations may exist at the federal, state, or local level and may include standards based on performance, emissions, technology, or health. In general, the structure of these regulations is similar. Each defines a set of conditions for which the regulation applies. These conditions might include a source type (e.g., a municipal waste combustor or sulfuric acid plant), an emission type (e.g., particulate matter or volatile organic compounds), operating conditions (e.g., tank capacity or process throughput), or time constraints (e.g., construction date or effective date). The work presented here focuses on federal regulations, though it can be extended easily to include state and local regulations.

Regulations at the federal level exist in several distinct categories including: New Source Performance Standards (NSPS), National Emission Standards for Hazardous Air Pollutants (NESHAP), New Source Review and Prevention of Significant Deterioration (NSR/PSD), New Source Review and Non-Attainment Area (NSR/NAA), and Maximum Achievable Control Technology (MACT) standards. Each of these categories of regulations is unique in its approach to controlling a pollutant or pollutants, though common features do exist between the different categories. These common threads can provide the basis for an automated search for applicable regulations. This will be discussed later in the paper.

NSPS, as promulgated under Section 111 of the Clean Air Act, are source specific regulations which limit the emission of specific pollutants from new stationary sources. For example, the NSPS for sewage treatment plants regulates the emission of particulate matter, and the NSPS for phosphate fertilizer industries regulates the emission of fluorides. Other NSPS may regulate sulfur dioxide, volatile organic compounds, carbon monoxide, total reduced sulfur, lead, nitrogen oxides, or acid gases. NSPS are technology based standards which reflect the degree of emission control achievable through the best demonstrated technology, while also considering cost.

NESHAPs are largely technology based standards, the exceptions being the NESHAPs for mercury and beryllium which are designed to prevent the exceedance of specified ambient concentrations. Source types regulated under the NESHAP program have emissions which contain one or more chemicals considered to be hazardous. Chemicals for which there are NESHAP standards include: arsenic, asbestos, benzene, beryllium, mercury, radionuclides, and vinyl chloride.

The NSR/PSD programs regulate sources to prevent further decline in air quality relative to the National Ambient Air Quality Standards (NAAQS). Under the PSD program a major source of a criteria pollutant may neither be constructed nor modified without including the best available control technology (BACT) for each pollutant subject to regulation. A BACT must reflect the maximum degree of emission reduction achievable considering energy, environmental effects, economic effects, and other costs.

The NSR/NAA program regulates the construction and operation of new and modified major stationary sources in NAAQS non-attainment areas. It requires the implementation of the lowest achievable emission rate (LAER). The potential emission rate for which a source becomes subject to NSR/NAA is based on the degree to which the area is non-attainment. In moderate and marginal ozone non-attainment areas the lower potential emission rate is 100 tpy (tons per year) for both nitrogen oxides (NO_x) and volatile organic compounds (VOCs), in serious ozone non-attainment areas the lower potential emission rate is 50 tpy, in areas of severe ozone non-attainment the lower potential emission rate is 25 tpy, and in extreme ozone non-attainment areas the lower potential emission rate is 10 tpy. Again, each of these lower potential emission rates applies to NO_x and VOC emissions.

With the identification of the 189 HAPs came the requirement for the maximum achievable control technology (MACT) at all new and existing major sources to reduce their emission. MACT standards are technology based standards and their stringency is tied to the performance of other sources in the same source category or sub-category. The categorization of the source is important in order to determine the appropriate MACT standard that must be met.

Existing Software Programs for Regulations

Most software packages which focus on regulations require the user to perform keyword searches on a database of regulations. These programs differ in their ease of use, presentation of search results, and flexibility. Programs are available on a variety of platforms including: Macintosh, DOS, and Microsoft Windows, with some versions taking advantage of the internet. To use these programs, the user searches the full text of a regulation database by part, sub-part, and section using a set of keywords or a phrase. The user can then mark sections of the text for future reference, annotate sections of the text which are relevant to the operations at his or her facility, export text for use in documents, or print sections of the text directly. The databases used by these programs can be updated on a variety of different schedules: annually, quarterly, monthly, and in the case of the internet versions, daily.

Though programs such as these represent a significant improvement over the traditional paper search of the Federal Register (FR), the Code of Federal Regulations (CFR), and other similar sources they remain labor intensive, and require the user to have source specific knowledge in order to perform directed searches. The user must have detailed knowledge of the source, its mode of operations, what chemicals are used in its operation, what chemicals are output from the source, and the various means of classifying the source. Many facilities, particularly smaller facilities, do not have sufficient manpower or expertise to rely exclusively on these software packages. Through the use of the EXL language it is hoped that a system can be developed which would reduce both the time commitment and the level of expertise required to determine the potential applicability of environmental laws and requirements.

Development of an Alternative System for Assessing Applicable Regulations

Initial efforts to automate the testing of regulations for potential applicability centered on the writing of computer code to test the applicability of individual regulations. To test this approach, computer code was written for a sampling of NSPS and NESHAP regulations using the CLIPS programming language. Though this method proved effective, it did not prove to be practical. The addition of a new regulation to the database required the joint effort of an individual familiar with environmental regulations and an individual who is conversant in the programming language. Similarly, modification to a regulation also required the joint effort of these two individuals. Ideally, the end-user of the regulations program should be able to perform each of these tasks, i.e., adding and modifying regulations, easily and without the need for extensive programming skills. This approach to automating tests to determine the potential applicability of a regulation adds to the expertise required of the end user. As such, it was decided that a different approach was warranted. As source specific information is often limited it was also decided to approach the problem of automating a search for applicable regulations from the aspect of deciding which regulations do not apply to a given source. Development of a system to identify only applicable regulations from disparate data sources was deemed impractical, if not impossible. Development of a system to determine which regulations warrant further investigation to determine their applicability is more feasible, and still provides the end-user with useful information.

While developing algorithms for testing the applicability of a regulation it was observed that aspects of the individual regulations are similar in nature and that the programming became a series of variations on themes. For example, the computer code to test for the presence of acid gases in the emission stream of a municipal waste combustor is similar to the computer code used to check whether a storage tank is used for storage of petroleum liquids. This similarity in algorithms became the basis for defining a new data structure for treating regulations and requirements, and for choosing the EXL as a tool for its implementation.

The EXL was designed by Argonne National Laboratory to address specific attributes of problems related to air pollution.(1) It is similar to an object-oriented spreadsheet. Its data types are grouped by objects and are linked to form complex networks. As a development tool it allows rapid program development, has built-in error checking, allows for flexible data entry, can be extended easily by the end-user, and is less prone to error than other methods for developing computer code to describe regulation applicability. It is not a proprietary language, and source code changes can be written in

EXL. Physical units (e.g., "m/s") can be embedded directly into parameters and equations written in EXL with all unit conversions performed automatically.

While each group of regulations (e.g., NSPS, NESHAP, and MACT) displayed more features in common within the group than between groups, the base between the groups is sufficiently similar to identify a common structure upon which to base a data structure. Figure 1 illustrates an early version of this data structure.

As can be observed in Figure 1, four main categories of information were identified relative to each regulation: *Background Information* (e.g., definitions, notations, abbreviations, symbols, units, etc.), *Administrative Information* (e.g., titles, type of regulation, category), *Regulatory Applicability* (e.g., affected dates and applicable codes), and *Regulatory Compliance* (e.g., recordkeeping, testing, monitoring, and reporting). These categories encompass the variety of information presented in the FR, the CFR, and other sources. By defining a template for entering this information, algorithms to test the potential applicability of a regulation need to be developed only once. The library of testing algorithms based on this template forms a regulations data engine. Information from each individual regulation can be entered into this template structure to create a regulations database. This data engine can then serve as the basis for checking the potential applicability of regulations at a facility. By encoding the information for each source at a facility in a similar structure, the process of identifying regulations and their potential applicability can be automated. The EXL simplified the creation of the data structure and the coding of the functionality for the regulations data engine.

As the code was developed for implementation of the template structure for the regulations data engine refinements were made to its structure. These refinements are reflected in Figure 2. Changes to the data structure reflect organizational changes which were realized while encoding the algorithms for the data engine. The most noticeable change is the combining of the Background Information and the Administrative Information categories. Both sets of information help identify and support a regulation, but do not in themselves determine whether a regulation applies or whether its requirements are being met. For these reasons it was decided to combine these two categories of information into a single data structure. Other changes to the structure of the regulations data engine were made to test aspects of individual regulations which were identified as the regulations database was developed. Again, it should be noted that the goal in the development of the regulations data engine is the development of a system to determine which regulations do <u>not</u> apply to a particular source. The list of regulations generated by the program for a particular source is a list of regulations that potentially <u>might</u> apply to a particular source given available data.

To test the potential applicability of a regulation it is necessary to define several key elements associated with each regulation. The elements which have been found to be the most useful in this respect include: the Standard Industrial Classification (SIC) value, the Source Classification Code (SCC), the EPA's RACT/BACT/LAER Information System (BLIS) Process Code, facility location, affected dates (i.e., dates of construction, modification, reconstruction, and start-up), facility ownership, and chemical usage. Each of these elements is considered in more detail below. It should be noted that this listing is intended to provide the user with a sample of the type of tests that can be included in the regulations data engine. The list is <u>not</u> all inclusive.

SCC values are specified as single digit, 3 digit, 6 digit, or 8 digit values. A single digit value of "1" is simply an external combustion boiler. A three digit SCC value of "101" is an external combustion boiler used for electric generation. A 6 digit SCC value of "101002" is an external combustion boiler using bituminous coal for electric generation. A full 8 digit SCC value can specify a source to specific emission point, for example, an SCC value of "10100201" is a wet bottom external combustion boiler using pulverized bituminous coal for electric generation. As additional digits are specified, more information is known about the source. Ideally, each source tested with the regulations program would be specified with a full 8 digit SCC value. Though the specification of 8 digit SCC values for all sources at a facility is unlikely, the regulations data engine is designed to use all available information, including single digit SCC values, in determining the potential applicability of a regulation.

The BLIS Process Code value is a value specified by the Environmental Protection Agency's Office of Air Quality Planning and Standards (EPA OAQPS) and is similar to the SCC value. It uses a 5 digit value divided into two parts, i.e., xx.xxx. As fewer non-zero values are used, the description of the source becomes more specific. An advantage of the BLIS Process Code over SIC and SCC values is that the process descriptions associated with its values have a closer correspondence to the descriptions used in many federal regulations. The data structure of the Air Compliance Advisor (ACA) software program is based on BLIS Process Codes for this same reason, thus testing of the regulations data engine, as previously discussed, within the ACA was easily implemented. In many cases the BLIS Process Code will be defined automatically for a source once its source type is identified.

By defining both the sources at a facility, and the regulations in the regulations database in terms of SIC, SCC, and BLIS Process Code values it is possible to perform an applicability determination with a degree of accuracy. Two approaches are used in defining SCC and BLIS Process Code values for an individual regulation. First, the codes which apply to a regulation can be specified. Second, the codes which do <u>not</u> apply to a regulation can be specified. It should be noted that only one set of values (i.e., applicable or non-applicable) should be specified in the regulations database. Some regulations apply to a very specific source in which case it is easier to identify applicable SCC and BLIS Process Code values. Other regulations apply to a wide range of sources in which case it is easier to identify non-applicable SCC and BLIS Process Code values. Specification of these values allows for the identification of applicable regulations when little is known of a source This is necessary to ensure that regulations governing above ground storage tanks are "flagged" though the source may be specified only as a "storage tank." Though the specification of these values is useful in the determination of the applicability of a regulation, it is not necessary for these values to be specified. A determination of the applicability of a regulation can still be made based on other information contained in the regulation database.

Other factors which affect the applicability of a regulation and are included in the regulation data engine include: the facility location, all applicable dates associated with the regulation, and facility ownership information. The location of a facility is significant for several reasons. A regulation may apply to all sources throughout the United States regardless of its location, it may apply to all sources within a particular region (as defined by the EPA), it may apply to only those sources located in a particular state, or it may apply to all sources located in some other geographical area. A regulation may apply to only sources located in a specific PSD class area (i.e., Class I, Class II, or Class III), or it may apply to only those sources located in an area of attainment or non-attainment with respect to one or more criteria pollutants. Alternatively, some regulations apply to sources which are constructed or modified after a particular date, while other regulations must be met within a specified time period after the source commences operation. Each of these classifications helps define a regulation's applicability in relation to a geographical area and a period in time.

The non-uniformity of regulations at all levels and the fact that the parameters included in the regulation data engine are not defined explicitly in the text of a regulation requires the person(s) responsible for the regulations database to have a thorough understanding of the regulations. Once the regulations have been entered into the data structure, the requirements of the end user are significantly reduced. In order to better understand the process of encoding a regulation, portions of the NSPS for Asphalt Processing and Asphalt Roofing Manufacturing will be considered. This is intended as only a simple example to illustrate key points in describing a regulation. The description of the regulation is not complete.

> ***60.470 Applicability and designation of affected facilities***
> *(a) The affected facilities to which this subpart applies are each saturator and each mineral handling and storage facility at asphalt roofing plants; and each asphalt storage tank and blowing still at asphalt processing plants, petroleum refineries, and asphalt roofing plants.*
> *(b) Any saturator or mineral handling and storage facility under paragraph (a) of this section that commences construction or modification after November 18, 1980, is subject to the requirements of this subpart. Any asphalt storage tank or blowing still that processes and/or stores asphalt used for roofing only or for roofing and other purposes, and that commences construction or modification after November 18, 1980, is subject to the requirements of this subpart.*
> *(c) Any asphalt storage tank or blowing still that processes and/or stores only nonroofing asphalts and that commences construction or modification after May 26, 1981, is subject to the requirements of this subpart.*

As this regulation specifies two dates, one for asphalt used for roofing the other for asphalt used for nonroofing purposes, two cases of this regulation are created. Most regulations specify a single affected date thus multiple cases are not required. The NSPS for Asphalt Processing and Asphalt Roofing Manufacturing was chosen for this example because it is unique in this respect. The applicability data for both cases of this regulation are listed below. It should be noted that it is not necessary to specify a value or values for each parameter in the data structure.

Case 1: asphalt used for roofing purposes

Construction Date: > November 18, 1980
Modification Date: > November 18, 1980
Applicable SCC Values: 3 chemical manufacturing
305 petroleum industry, asphalt roofing
305001 petroleum industry, asphalt roofing, asphalt blowing
30500101 petroleum industry, asphalt roofing, asphalt blowing, saturant
30500102 petroleum industry, asphalt roofing, asphalt blowing, coating
30500103 petroleum industry, asphalt roofing, felt saturation, dipping only
30500104 petroleum industry, asphalt roofing, felt saturation, dripping/spraying
30500105 petroleum industry, asphalt roofing, felt saturation, general
30500110 petroleum industry, asphalt roofing, felt saturation, blowing
30500111 petroleum industry, asphalt roofing, felt saturation, dripping only
30500112 petroleum industry, asphalt roofing, felt saturation, spraying only
30500113 petroleum industry, asphalt roofing, felt saturation, dripping/spraying

30500198 petroleum industry, asphalt roofing, not classified
30500199 petroleum industry, asphalt roofing, not classified
305002 petroleum industry, asphalt concrete, rotary dryer
30500201 petroleum industry, asphalt concrete, rotary dryer, conventional plant
30500202 petroleum industry, asphalt concrete, hot elevators, screens/bins/mixer
30500203 petroleum industry, asphalt concrete, storage piles
30500204 petroleum industry, asphalt concrete, cold Ag handling
30500205 petroleum industry, asphalt concrete, drum dryer, hot asphalt plant
30500206 petroleum industry, asphalt concrete, asphalt heater, natural gas
30500207 petroleum industry, asphalt concrete, asphalt heater, residual oil
30500208 petroleum industry, asphalt concrete, asphalt heater, distillate oil
30500211 mineral products, asphaltic concrete, rotary dryer
30500299 petroleum industry, asphalt concrete, not classified
305999 miscellaneous mineral products, not classified
30599999 miscellaneous mineral products, not classified

Applicable BLIS Process Codes: 90.000 mineral products

90.002 asphalt/coal tar application - metal pipes
90.003 asphalt concrete manufacturing
90.004 asphalt processing (except 90.002, 90.003 & 90.034)
90.034 asphalt roofing products manufacturing
90.999 other mineral processing sources

Case 2: asphalt used for nonroofing purposes

Construction Date: > May 26, 1981
Modification Date: > May 26, 1981
Applicable SCC Values: 3 chemical manufacturing

305 petroleum industry, asphalt roofing
305002 petroleum industry, asphalt concrete, rotary dryer
30500201 petroleum industry, asphalt concrete, rotary dryer, conventional plant
30500202 petroleum industry, asphalt concrete, hot elevators, screens/bins/mixer
30500203 petroleum industry, asphalt concrete, storage piles
30500204 petroleum industry, asphalt concrete, cold Ag handling
30500205 petroleum industry, asphalt concrete, drum dryer, hot asphalt plant
30500206 petroleum industry, asphalt concrete, asphalt heater, natural gas
30500207 petroleum industry, asphalt concrete, asphalt heater, residual oil
30500208 petroleum industry, asphalt concrete, asphalt heater, distillate oil
30500211 mineral products, asphaltic concrete, rotary dryer
30500299 petroleum industry, asphalt concrete, not classified
305999 miscellaneous mineral products, not classified
30599999 miscellaneous mineral products, not classified

Applicable BLIS Process Codes: 90.000 mineral products

90.002 asphalt/coal tar application - metal pipes
90.003 asphalt concrete manufacturing
90.004 asphalt processing (except 90.002, 90.003 & 90.034)
90.999 other mineral processing sources

This information is entered into the regulation database as two separate cases and serves as the basis for determining the applicability of the regulation. It should be noted that generic values are included in the listings of SCC and BLIS Process Code values to account for sources which are poorly defined. Case 1, as listed above, does not exclude non-roofing asphalt processes from the list of applicable BLIS Process Codes and SCC values as these processes can occur in conjunction with asphalt roofing processes.

The aforementioned regulations data engine and regulations database were implemented and tested as part of the development of the Air Compliance Advisor (ACA) software package. The ACA is a program designed to assist air pollution managers in developing a scheme for addressing air pollution compliance issues by considering source characterization, and emission reduction techniques.(2) Figures 3-6 illustrate the structure of the regulations data engine within the ACA using the example data above. Figure 3 illustrates the regulations data engine as part of the ACA's library object with individual regulation lists for NSPS, NESHAP, MACT, and other regulations. Figure 4 illustrates the contents of the NSPS regulations library and the two cases for the NSPS for Asphalt Processing and Asphalt Roofing Manufacturing. Figure 5 illustrates the applicability data for case 1 of the Asphalt Processing and Asphalt Roofing Manufacturing NSPS including the data as previously identified. Figure 6 indicates the affected dates for the Asphalt Processing and Asphalt Roofing Manufacturing NSPS as previously identified.

Status of the Regulations Data Engine

The beta test versions of the regulations data engine and associated database of regulations, as developed for use in the ACA, can determine the potential applicability of NSPS, NESHAP, and MACT standards, as well as NSR/PSD and NSR/NAA requirements. The applicability determination is based on tests of the BLIS Process Code (both applicable and non-applicable), SCC values (both applicable and non-applicable), affected dates, applicable chemicals, attainment status of the region, facility ownership, and SIC values. Functions to test each of these parameters have been constructed and implemented. The data engine and associated database are considered beta-test versions as further testing is required of the applicability functions and the contents of the database need to be verified. It is hoped that an independent party or parties can be identified to perform checks of the database and testing functions. The current version of the ACA program (version 5.22b), including the regulations data engine, is available from the U.S. Environmental Protection Agency's Control Technology Center (CTC) bulletin board, and from the ACA Development Group's world wide web site (http://quattro.me.uiuc.edu/~acad/) Future development of the regulations data engine and regulation database will focus on the development and implementation of functions for compliance checking. As new regulations are promulgated these regulations will be added to the current regulation database.

Conclusions

An automated system was designed and implemented for testing the potential applicability of air pollution regulations. The regulations data engine was implemented as part of the development of the ACA software program. This system is designed to help environmental personnel at both federal facilities and in the private sector assess the applicability of federal regulations, and can be extended easily to include state and local regulations. Using the special-purpose programming language EXL the regulations data engine is easily extended by the end user and does not require extensive computer programming skills. The initial results from this work indicate that an automated system for determining the potential applicability of a regulation is both feasible and beneficial.